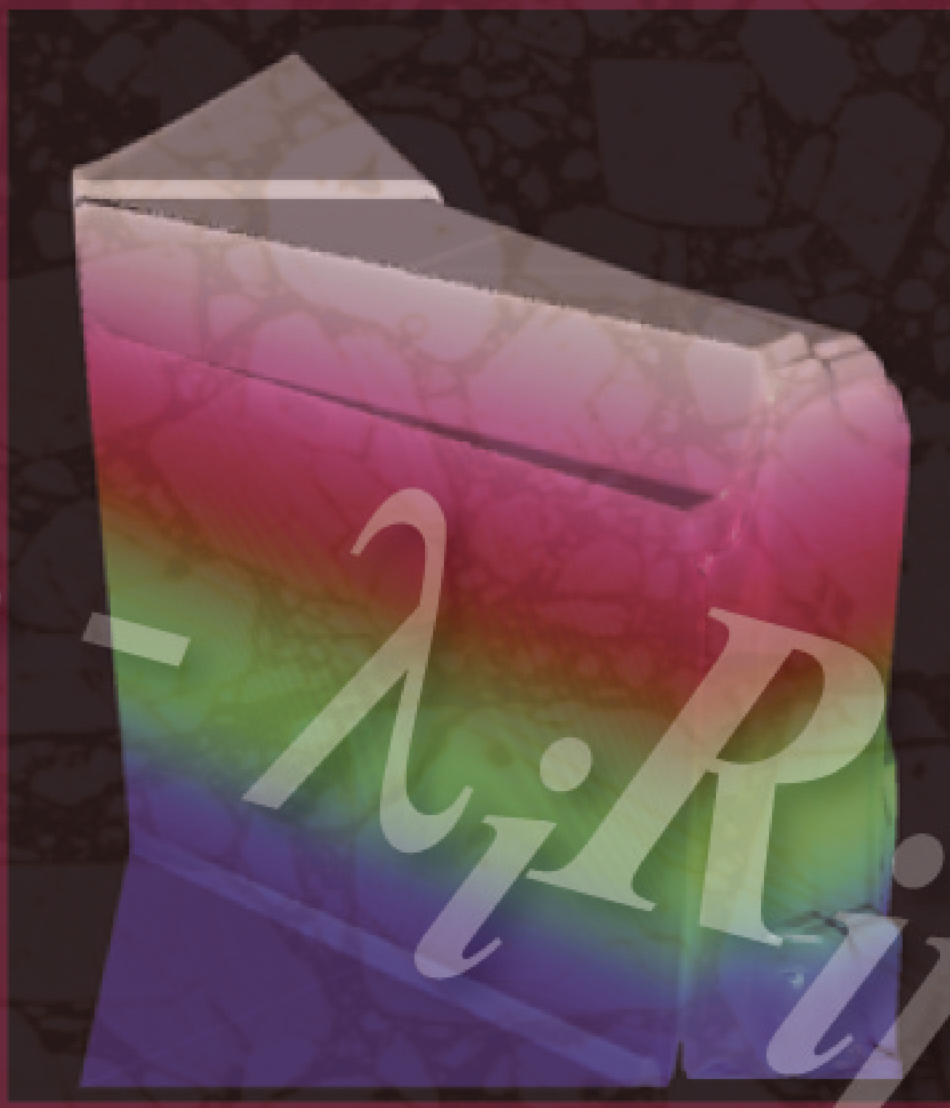
Nuclear Weapons Program

Highlights 2005-2006



T | Theoretical Division

Los Alamos NATIONAL LABORATORY

The World's Greatest Science Protecting America

About the cover: The ***background image*** *relates to a scanning electron micrograph of a low-density, open-cell, polyurethane foam showing the intricate, disordered, geometric structure at the cellular scale. Material provided courtesy of the Dow Chemical Company, and micrograph provided courtesy of David J. Alexander, MST-6, p. 24.*

The ***inset image*** *shows the pressure surface in spacetime for Sn sample subject to impact loading. Time advances to the right and space coordinate is out of the page. Viewpoint is from Sn free surface with impactor in the back. The "shelf" in the pink part of the wave is due to the* β*-body-centered tetragonal phase transition, p. 7.*

The ***equation*** *overlay is part of the article on p. 6.*

Theoretical Division
Nuclear Weapons Program Highlights

2005-2006

Issued June 2006

Division Leader
Alan R. Bishop

Deputy Division Leader
Paul J. Dotson

Publication Designer
Sharon Mikkelson

Editor
Denise Sessions

Printing Coordinator
Guadalupe D. Archuleta

We gratefully acknowledge the authors who contributed to this publication.

Address mail to
Los Alamos National Laboratory
Theoretical Division Office
P.O. Box 1663, Mailstop B210
Los Alamos NM 87545

http://www.lanl.gov/orgs/t
Tel: 505.667.4401, Fax: 505.665.4055

• Unclassified •

Theoretical Division
Nuclear Weapons Program Highlights
2005-2006

Preface:

The Theoretical (T) Division continues to play a pivotal role for the Nuclear Weapons (NW) Program, serving as the principal steward for the theory and modeling capabilities in the areas of dynamic materials response and equation of state, nuclear, atomic and plasma physics, fluid mechanics, and computational methods for the NW program, and for other programs at Los Alamos National Laboratory. These capabilities are brought to bear on the increasingly challenging problems arising from the Stockpile Stewardship Program, as well as newer elements of the NW program such as the Reliable Replacement Warhead. In order to validate a truly predictive simulation capability, the fidelity of the underlying physics descriptions must continue to improve, and this requires the development and implementation of more sophisticated physics models into the simulation codes, in a close partnership with our experimental, modeling, and simulation colleagues.

Researchers in T-Division work with theoretical colleagues in other divisions, and with coworkers in experimental divisions to produce models of physical behavior. These models ultimately are expressed in continuum form, but draw from subscale modeling and theory to best capture those macroscopic effects that are driven by phenomena at atomic or mesoscales. These models are validated by fundamental, scientific data, parameterized, and implemented into codes, to be further tested against evermore complex integral experiments. The improved capability resulting from these newer-generation physics models is making significant differences in our ability to fulfill our stockpile stewardship responsibilities.

The future challenge is in the more general context of Science-Based Prediction, where the natural scientific partnerships described above are purposefully applied to a broad array of national-level security problems, on scales befitting a national laboratory.

Paul J. Dotson
Deputy Division Leader, Theoretical Division

Los Alamos
NATIONAL LABORATORY
EST. 1943